Fachgebiet für Geothermal Technologies
TUM School of Engineering and Design
Technische Universität München

TUM.GTT Master thesis topics, 2024

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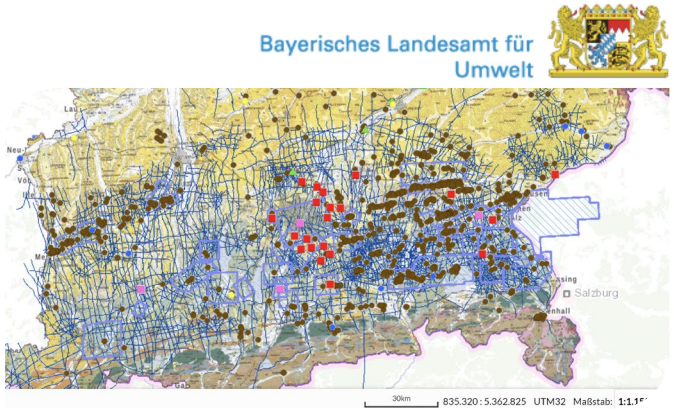
Seismic geohazard mapping in the Bavarian Foreland Molasse Basin

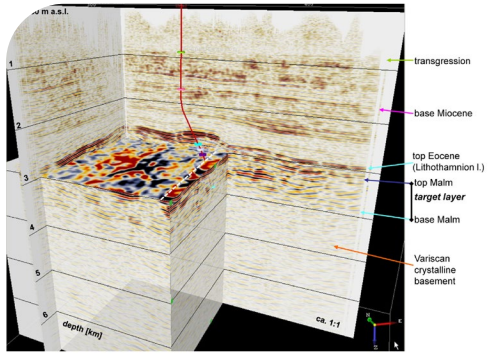
Motivation

The Bavarian Foreland Molasse Basin (BFMB) is Germany‘s most important deep geothermal energy play. Typical for a Cenozoic foreland basin, drilling in the BFMB is challenged by the geological conditions. These geological challenges are also called geohazards and comprise of elevated pore fluid pressures (overpressure), instable formations and gas accumulations. Although abundand 2D and 3D seismic data is available from past oil and gas exploration in the BFMB a geohazard map is not available yet. The scope of this thesis is to map reported geohazards using 2D and 3D seismic interpretation in a selected subarea of the BFMB and to develop workflows how to identify these hazards on seismic data in the BFMB.



Tasks and requirements

- Identify geohazards in a selected set of already drilled oil and gas and deep geothermal wells
- Structural and stratigraphic interpretation of 2D and 3D seismic data
- Well tie and correlation of identified geohazards with seismic markers
- **Requirements**: Interest in geology, geophysics and 3D geology
- **Work type**: Office only (work place is in GTT-offices in RiWa 3, Munich)
- **Context**: The master thesis is linked to several research projects related to deep geothermal energy.



E. Lüschen et al. / Geothermics 50 (2014) 167–179

Supervisor(s)

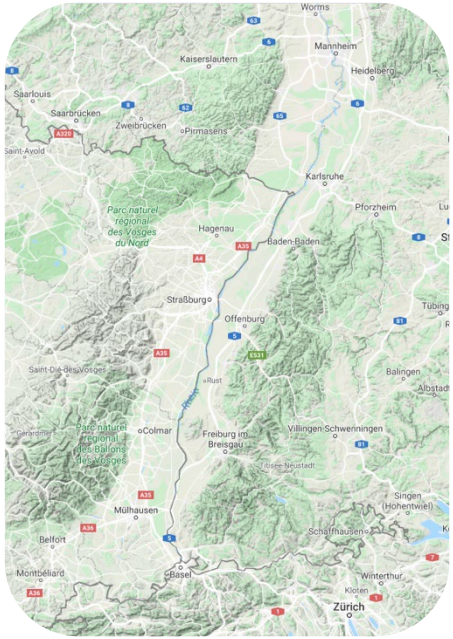
Michael Drews (michael.c.drews@tum.de)
Florian Duschl (florian.duschl@tum.de)

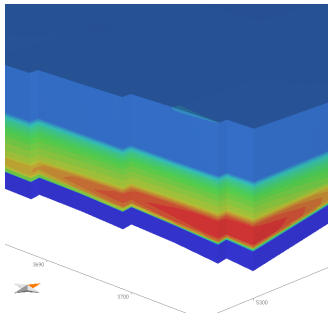
Overpressure modelling in the Upper Rhine Graben (URG)

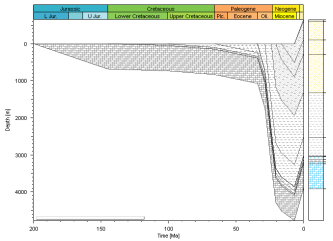
Motivation

Overpressure is the excess pressure above normal hydrostatic pressure. Quantification of overpressure is important for reservoir characterization, production, seismic processing, well planning and safe drilling, but also for understanding the structural evolution of sedimentary basins.

Pore pressure in the UGR is believed to be at hydrostatic levels throughout. However, there are signs (drilling problems, sedimentation rates) that overpressure might be present in at least some parts of the UGR.







Tasks and requirements

- Literature review on URG stratigraphy, structural evolution and geomechanical (pressure, stress) and petrophysical (porosity, permeability) properties
- Build dynamic 1D and 3D basin models for URG
- Investigate different petrophysical configurations for overpressure generation
- **Requirements**: Interest in geology, modelling and deep geothermal energy
- **Work type**: Mainly office (modelling), but optional field and lab work
- **Context**: This work is part of the Pore Pressure Map (PoPMap) Germany initiative of TUM.GTT

Supervisor(s)

Michael Drews (michael.c.drews@tum.de)
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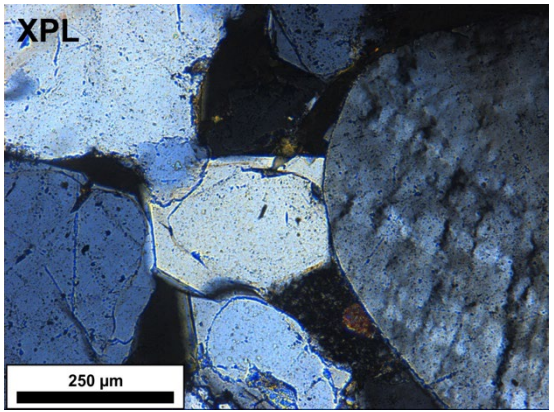
Microstructural strain analysis in sandstones from the North Alpine Thrust Front

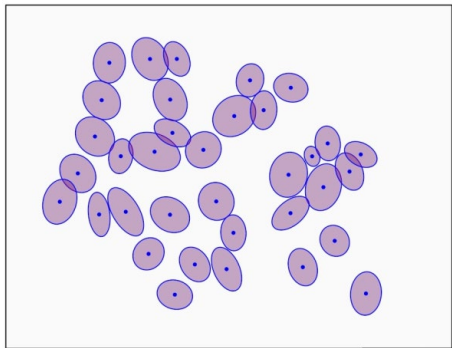
Motivation

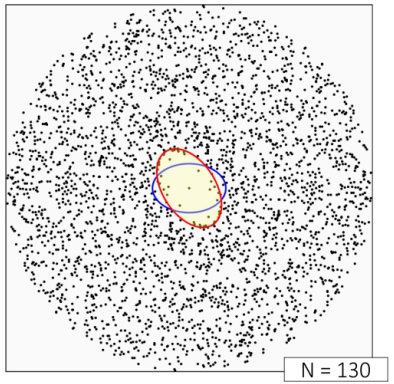
Microstructural analysis on clastic sedimentary rocks can help to determine amount and local range of deformation along a major thrust front. In this context, the microstructural deformation of (quasi-)spherical detrital particles like rounded sand grains can be used to a) identify direction of paleostress tensors, and b) provide information on the amount and range of deformation within the folded rock units. Therefore, thin sections of core and outcrop sandstone samples from the Foreland Molasse and the Subalpine Molasse in Bavaria are analysed using different microscopic methods. In addition, finite strain analysis is applied to quantify deformation features.



Tasks and requirements

- Perform microscopic analyses (standard/digital petrographic microscopy, optional: cathodoluminescence microscopy) on thin sections and identify microstructural deformation features (microfractures, pressure solution features)
- Quantify amount of deformation and determine paleostress tensors using finite strain analysis (Fry, Rf/φ) in 2D/3D
- **Requirements**: Interest in structural geology, labwork and statistical analysis
- **Work type**: 60% lab work, 40% statistical analysis/modeling





Supervisor(s)

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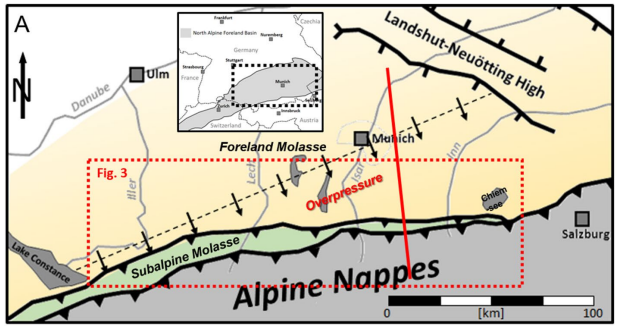
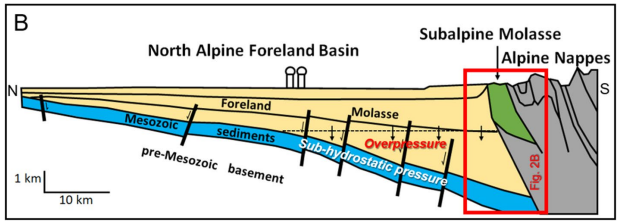
Compaction across Subalpine shale detachments

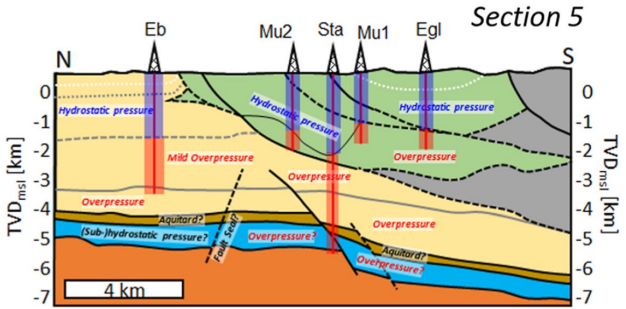
Motivation

The Subalpine Molasse is the transition zone between the Northern Alps and the North Alpine Foreland Basin with complex structural geology and several shale detachments. The physical properties of these detachments are of fundamental scientific interest to understand the evolution of the Subalpine wedge, natural seismicity and the stress field in the North Alpine Foreland Basin.

Several wells have been drilled through and cored these detachments, but have never been analysed for their petrophysical properties. In this topic you would measure basic properties such as density and porosity to understand the compaction state of shales from the Subalpine wedge, the detachment and stratigraphical counterparts from the foreland basin part.







Tasks and requirements

- Detailed structural sample description and correlation with geophysical well logs and pre-interpreted (seismic) cross-sections
- Measuring of density and porosity
- Interpretation of results in the subregional geological context using MS-Excel and ArcGIS

Supervisor(s)

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If you are interested in one of our topics

Please send your CV, transcript of records and a short (~250 words) motivation text explaining why you would like to work on the respective thesis topic to:
Michael Drews (michael.c.drews@tum.de) or Florian Duschl (florian.duschl@tum.de)

Additional thesis topics might become available, and will be posted here:
https://www.cee.ed.tum.de/gtt/teaching/bsc-and-msc-theses/

Also feel free to contact us with your own thesis topic ideas. Please check our website to get an idea which topics we can supervise: www.cee.ed.tum.de/gtt